3 QUALITY ASSURANCE/ QUALITY CONTROL PLAN

3.1 Quality Assurance Objectives

The overall QA objective for measurement data is to obtain data of known and acceptable quality. All measurements will be made to yield accurate and precise results representative of the media and conditions measured. All data will be calculated and reported in units consistent with those used by regulatory agencies to allow for comparability of data. QA objectives for precision, accuracy, and completeness have been established for each measurement variable, where possible, and are presented in Table 1.

3.2 Analytical Procedures

The analytical methods for the analyses are summarized in Table 1. Analysis of the samples will be performed by using procedures based on the following methods:

- Method 300.0: nitrate by ion chromatography (USEPA, 1983)
- Method 8151A: chlorinated herbicides by gas chromatography/electron capture detector or electrolytic conductivity (USEPA, 1998)

Any special analytical method that is employed will be determined with laboratory concurrence prior to beginning sample analysis.

3.3 Data Reduction, Validation, and Reporting

The laboratory performing sample analyses will be required to submit summary data and QA information to permit independent and conclusive determination of data quality. The determination of data quality will be performed using the following as guidelines for data review: *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses* (EPA, 1988a), and *Laboratory Data Validation Guidelines for Evaluating Organics Analyses* (EPA, 1988b).

Laboratory deliverable requirements for the chemical analyses will include the information outlined below and in Table 2.

- A cover letter for each sample batch will include a summary of any quality control, sample, shipment, or analytical problems, and will document all internal decisions. Problems will be outlined and final solutions documented. A copy of the signed chain of custody form for each batch of samples will be included in the narrative packet.

- Sample concentrations will be reported on standard data sheets in proper units and to the appropriate number of significant figures. For undetected values, the lower limit of detection for each compound will be reported separately for each sample. Dates of sample extraction or preparation and analysis must be included.

- A method blank summary will be included.

- Surrogate percent recovery will be calculated and reported.

- MS/MSD percent recoveries, spike level, and relative percent difference will be included.

- A list of the detection limits calculated for laboratory instruments for all analytes will be included.

Sample holding times will be calculated by comparing the date of sample collection (shown on the chain of custody) with the date of sample analysis. All laboratory deliverables will be reviewed for data validation of chemical analyses. The main items for review are described in Table 3.

3.4 Data Assessment Procedures

Accuracy, precision, completeness, representativeness, and comparability are terms used to describe the quality of analytical data. Routine procedures for measuring precision and accuracy include use of replicate analyses, standard reference materials (SRMs), matrix spikes, and procedural blanks. Replicate matrix spikes and method blanks will be analyzed by the selected laboratory. Additional spikes and replicate analyses may be implemented. The minimum frequencies are as follows:

- Replicate analysis

  - Nitrate and chlorinated herbicides: 10 percent of the groundwater samples will be analyzed as laboratory duplicates.

- Matrix Spike

  - Nitrate and chlorinated herbicides: one matrix spike will be analyzed per sample batch.

- Method Blank

  - Nitrate and chlorinated herbicides: one preparation blank per matrix will be analyzed for each sample batch.

Quality of analytical data represented by precision and accuracy are calculated using the mean, standard deviation, and percent recoveries. The mean, C, of a series of replicate measurements of concentration, C_i, for a given analyte will be calculated as:

$$\overline{C} = \frac{1}{n}\sum_{i=1}^{n} C_i$$

where:

n = Number of replicate measurements

The estimate of precision of a series of replicate measurements can be expressed as the relative standard deviation, RSD:

$$\text{RSD} = \frac{SD}{\overline{C}} X \ 100\%$$

where:

SD = Standard deviation:

$$SD = \frac{\sqrt{\sum_{i=1}^{n} (C_i - \overline{C})^2}}{(n-1)}$$

Alternatively, for data sets with a small number of points (e.g., duplicate measurements), the estimate of precision will be expressed as a relative percent difference (RPD):

$$RPD = \frac{C_1 - C_2}{\overline{C}} x\, 100$$

where:

C_1 = First concentration value or recovery value measured for a variable

C_2 = Second concentration value or recovery value measured for a variable

Accuracy as measured by matrix spike or laboratory control sample results will be calculated as:

$$\text{Recovery} = \frac{\Delta C}{C_s} \; x \; 100$$

where:

ΔC = The measured concentration increase due to spiking (relative to the unspiked portion)

C_s = The known concentration increase in the spike

Accuracy can also be measured by analysis of standard reference material (SRM) or regional reference material and will be determined by comparing the measured value with the 95 percent confidence interval established for each analyte.

Completeness will be measured for each set of data received by dividing the number of valid measurements actually obtained by the number of valid measurements that were planned.

3.5 Field Quality Assurance

Field quality assurance (QA) will be maintained through compliance with the sampling plan, collection of field QA samples, and documentation of sampling plan alterations.

Duplicate groundwater samples will be collected at a minimum frequency of 10 percent of the total number of samples. Duplicate samples will be labeled similar to the other samples and submitted blind to the laboratory. The locations for duplicate sample collection will be determined in the field. If problems arise during field sampling, a Sampling Alteration Checklist (Figure 6) will be completed by the site QA officer.